Materials Science

THE EFFECTS OF 3.0 KEV PROTON IRRADIATION ON THE CGS/C-SI TANDEM SOLAR CELL, Beau A. Meredith[1], Hugh E. Siefken*[1], Arlene J. Larabee[1], George R. Peters[1], David L. Young[2], Greenville College[1], 315 E College Ave, Greenville, IL 62246, National Renewable Energy Laboratory[2], 1617 Cole Boulevard, Golden, CO 80401-3393, arlene.larabee@greenville.edu

The purpose of this experiment was to test the radiation hardness (a measure of a solar cell's ability to operate near its maximum efficiency after being irradiated with protons or electrons) of the ZnO/CdS/$CuGaSe_2$/c-Si (CGS/c-Si) tandem solar cell using an ion accelerator. Tandem solar cells are (theoretically) more efficient than single-junction solar cells. The $CuGaSe_2$ (CGS) solar cell has an optimal band-gap for use as the top layer in a tandem design with the c-Si solar cell, making it a promising tandem candidate [1]. In previous studies, single junction $Cu(In,Ga)Se_2$ (CIGS) cells – solar cells similar in structure to CGS cells – have consistently been shown to be very radiation hard [2]. However, the radiation hardness of the tandem CGS/c-Si tandem cell has not been established. If this tandem cell can be shown to be radiation hard, it may be a candidate for use in the solar radiation environment found in outer space [3]. In order to test the radiation hardness of the tandem cell, the Greenville College ion accelerator was used to irradiate the cell with 3.0 keV protons. The ion accelerator serves to simulate the low-energy side of the solar radiation spectrum in outer space. In the experiment, the diode characteristics of the cell were measured before and after each irradiation. The cell did not exhibit significant degradation in efficiency or other solar cell parameters up to proton fluences of 10^{15} protons/cm^2, and thus the cell proved to be radiation hard under the conditions in the laboratory. The results seem promising. However, further studies are needed at the high-energy end of the solar radiation spectrum in order to fully establish the radiation hardness of the CGS/c-Si tandem solar cell.

References

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